

SECTION 2.0

EXISTING CONDITION/AFFECTED ENVIRONMENT

2.1 GEOLOGY AND SOILS

Florida geology has been shaped by a succession of marine and non-marine processes driven by major sea level fluctuations. The Florida platform is composed primarily of limestone sequences 2,000 ft thick to the north and more than 5,000 ft thick to the south. The platform, situated in warm tropical and subtropical seas with depths less than 100 meters, created favorable conditions for carbonate production and deposition, forming predominantly limestone lithostratigraphy of Florida. Sea level fluctuations caused widespread dissolution of accreted limestone, creating large caverns, sinkholes, springs, and other porous features that define karst terrains. These karst features occur in most limestone units, largely affecting surface expression and aquifer characteristics.

Florida lithology, chiefly composed of limestone, varies throughout the platform because of physiographic differences throughout the state. The southern part of the state, due to higher subsidence rates, remained mostly submerged and produced carbonate sediments throughout most of depositional history. For 120 million years, from mid-Jurassic to the beginning of the Tertiary period, salt deposits left from evaporation known as Cedar Creek Formation, form the confining base of the Floridan aquifer. From Tertiary to the late Oligocene epoch, with the Suwannee Trough preventing clastic incursions north, clean and pure limestone deposits dominated the lithology. During this period, the Suwannee Limestone and the Ocala Limestone, including the Avon Park Formation and the Oldsmar Formation formed. These deposits make up the Floridan Aquifer in South Florida. During the early Miocene, a major drop in sea level and an increase in siliciclastic sediment intrusion from the north curtailed most carbonate deposition except along southern peninsular Florida. Eventually the siliciclastic sediments covered all parts of the platform. The Hawthorn Group, which acts as the intermediate aquifer system and confining group, resulted from this depositional pattern. Overlying the Hawthorn Group in southeast Florida is the Pleistocene age Miami Limestone, which forms the unconfined Biscayne Aquifer.

Underlying structural features on the Florida Peninsula have influenced depositional patterns throughout its geologic history. One such feature, the Florida Peninsular Arch, extended from southern Georgia to just above Lake Okeechobee. Positive, higher elevation features tended to become subaerial (exposed to atmosphere) and eroded, whereas negative, topographically low features often remained submerged and accretional. This pattern tended to create unconfined, surficial aquifers in elevated areas and confined aquifers in the depressed areas. Unconfined aquifers in topographic highs became recharge areas. Lows, such as the Suwannee Trough, tended to remain depositional, often resulting in the formation of confining layers atop or within the limestone deposits. Topographic highs, such as the Peninsular Arch, were the first to become subaerial when sea levels dropped. Once subaerially exposed, dissolution of the exposed limestone from surface water – groundwater interaction and groundwater – seawater interactions, creating significant secondary porosity within the

limestone. This karst, secondary porosity resulted in the formation of the Floridan Aquifer, one of the largest aquifer systems in the world.

During the last 20,000 years, the sea level has risen approximately 120 meters. Approximately 8,000 years ago, the rate of sea level rise sharply decreased to almost zero. Sediments depositing during this period, which overlie much of Florida's older sediments, including the Miami Limestone, are most often quartz sands, and often make up parts of the surficial aquifer. The Miami Limestone bedrock is soft oolitic, generally less than 40 feet thick, and considered to be a part of Biscayne aquifer. The base of the aquifer is generally considered the deepest porous limestone bed in the section above the relatively impermeable sand, silt, and clay of Hawthorn Group or "tight" sand in the Tamiami Formation. Other sediments deposited during the sharp decrease in sea level rise include peat deposits, clay beds, and freshwater carbonates in the Everglades area. This newest layer is known collectively as the Undifferentiated Pleistocene-Holocene Sediments.

The Lower East Coast on the Atlantic Coastal Ridge is mostly underlain by thin sand and Miami Limestone that are highly permeable and moderately to well drained. The soil of the Tamiami Trail project area is mainly of the Lauderhill-Dania-Pahokee Association, which consists of nearly level, poorly drained soils containing organic material eight to more than 51 inches deep over limestone bedrock. These soils extend west from Atlantic Coastal Ridge into the Everglades. Typically, the soils are black to dark brown muck underlain by soft porous limestone. The soil limitations that affect building site development and water management are considered severe due to high subsidence, ponding, excess humus, low strength, and the depth to bedrock features.

2.2 WATER MANAGEMENT

SFWMD is working cooperatively with other agencies to develop scientifically sound approaches for managing the distribution and timing of water to the remaining natural systems. The studies are focused on: (1) water supply needs of lakes and wetlands in terms of water levels, duration, timing, and distribution of water deliveries; (2) minimum water levels and the time duration that these levels need to be maintained to protect groundwater systems from overuse or from saltwater intrusions; (3) minimum flows and levels for rivers and estuaries needed to maintain streamflow characteristics and biological communities. Florida law requires the designation of the areas in SFWMD where water resources are critical or anticipated to become critical over the next 20 years as Water Resource Caution Areas. Much of South Florida including the Everglades has been designated as Water Resource Caution Area.

2.2.1 Water Supply

Levees and canals divide the former Everglades into areas designated for development and areas for fish and wildlife benefits, natural system preservation, and water storage. The natural areas are divided into the three WCAs and ENP. The WCAs store excess surface water during wet periods and are a main source of recharge during the dry season for the coastal aquifers along the lower east coast.

The water management of the project area is mainly controlled by the activities of WCAs. The primary purposes for the WCAs and their appurtenant levees, canals, structures, and pump stations include flood control, water conservation, prevention of salt-water intrusion, recreation, preservation of fish and wildlife, and water supply for ENP. WCAs include about 1,400 miles of canals and levees, 181 major water control structures, over 2,000 minor control structures, and 18 major pumping stations. The WCAs are completely contained by levees, except for about seven miles on the western side of WCA-3A, which has a tieback levee. There are also levees on the eastern side of the Everglades that protect the agricultural and industrial areas that otherwise would be short hydroperiod wetlands from inundation. The main canals are West Palm Beach Canal, Miami Canal, Bolles and Cross Canals, North New River Canal, South New River Canal, Hillsboro Canal, and Tamiami Canal.

The WCAs provide detention for excess water from the agricultural area and parts of the East Coast region and for flood discharge from Lake Okeechobee to the sea. The levees to prevent floodwaters from inundating the east coast urban areas; provide a water supply for east coast areas and ENP; improve the water supply for east coast communities by recharging underground freshwater reservoirs; reduce seepage; ameliorate salt-water intrusion in coastal wellfields; and benefit fish and wildlife in the Everglades. The regulation schedules on how project spillways are to be operated to maintain water levels in the WCAs essentially represent the seasonal and monthly limits of storage. The schedules vary from high stages in the late fall and winter to low stages at the beginning of the wet season. This seasonal range permits the storage of runoff during the wet season for use during the dry season. In addition, it serves to maintain and preserve the vegetative regimen in the WCAs, which are essential to fish and wildlife and the prevention of wind tides. Regulation schedules must take into account various, and often conflicting, purposes. Conceptually, reservoir storage is commonly divided into the inactive zone, the water supply (conservation) zone, and the flood control zone. The distribution of water between the flood control and water supply zones varies seasonally in the WCAs. The regulation schedules for WCA-1, WCA-2A, and WCA-3A include a minimum water level, as measured in canals, below which water releases are not permitted unless water is supplied from another source. When water levels fall below the minimum levels, transfers from Lake Okeechobee or the WCAs are made to meet water supply demands. Currently, stages in the L-29 Canal are controlled at 7.5 feet or below based on legal constraints imposed by the Experimental Water Delivery Program.

2.2.2 Flooding

One of the Nation's worst natural disasters was the hurricane of 1928 when over 1,600 people were killed in the Everglades area. The Everglades area had already received 21 inches of rain during the first 15 days of September before the arrival of the Category 4 hurricane. The maximum-recorded flood stage in the Rocky Glades area occurred in the middle of the East Everglades in October 1947, following the passage of the third hurricane of the season. A stage of 9.0-ft NGVD was measured at L-31N and 168th Street. The area wide average May through October rainfall of 73.54 inches has a recurrence interval of about once every 35 years. The next year, a flood stage of 8.7 ft was measured. The 1959-60 flood was another notable flood. The construction of L-29 in 1962 would have significantly reduced these stages. Since then, only the

1968-1969 flood has caused widespread flooding in the area. Tropical storm *Dennis* in August 1981 caused extensive flooding and damages but it was centered more over Homestead where 19.39 inches was recorded in August 16-18. Most recently, Hurricane *Irene* (1999) impacted the area with water levels similar to those experienced during Tropical storm *Dennis*. Surface water levels in the area remained elevated long after the passage of the storm, resulting in property damage and loss of crops. According to the Miami-Dade County Agricultural Extension Service, losses throughout Miami-Dade County due to Hurricane Irene were approximately \$77,000,000 for vegetables, \$2,500,000 for field crops, \$150,000 for aquaculture, and \$126,000,000 for ornamental crops.

Many of the developed areas in southeastern Florida were formerly part of the Everglades. These areas depend on the C&SF system for flood protection. The regional canal systems provide flood protection to developed areas in eastern Dade, Broward, and Palm Beach counties. Local stormwater management systems collect and route stormwater to the regional canals, then discharge to the ocean via estuaries. Pollutants from agricultural and urban activities are also washed into stormwater and eventually discharge to receiving waters such as wetlands, lakes, and estuaries. South Florida Water Management District works with other local government and agencies to encourage integration, among land use, watershed management, and stormwater master plans. Under flood conditions, the focus of stormwater management becomes rapid and efficient removal of floodwaters regardless of impacts on water supply and natural systems.

The WCAs provide a detention reservoir for excess water from the agricultural area and parts of the Lower East Coast region and for flood discharge from Lake Okeechobee. Currently, stages in the L-29 Canal are artificially controlled at 7.5 feet or below. The design stage upstream of the L-29 Canal and downstream of Tamiami Trail is 9 feet. Prior to the construction of the C&SF project features, flow in the Everglades was uncontrolled, and stages varied greatly and at times overtopped Tamiami Trail. The Tigertail Camp, a Miccosukee Indian Villages situated on the berm strip formed between the L-29 Levee and the L-29 is located about five miles west of S-334. The Tigertail Camp mitigation plan has been completed and the Tigertail Camp has been raised above the anticipated water stages.

The Flood Control Act of 1965 authorized a plan to provide seasonal flood protection in Southwest Miami-Dade County. The plan consisted of levees, canals, water control structures, and pumping stations capable of removing 15 inches of runoff per month plus seepage into the area following a 10-year flood. The project was officially deauthorized after Congress expanded ENP to include most of the area that would have been protected.

2.3 WATER QUALITY

2.3.1 Surface Water

General. The water quality of the Everglades has been greatly influenced by development-related activities. Hydrologic alterations have led to significant changes in the landscape by opening large land tracts for urban development and agricultural

practices and by the construction of extensive drainage networks. Natural drainage patterns in the region have been disrupted by an extensive array of levees and canals such that nonpoint source (stormwater) runoff and point sources of pollution (wastewater discharges) are now part of the normal hydrological regime in many areas. Pollutants of concern include:

- Metals - mercury, copper, cadmium, lead, zinc, arsenic
- Pesticides - DDT and derivatives, atrazine, simazine, ametryn, endosulfan compounds, ethion, bromacil, 2,4-D, aldicarb, and fenamiphos
- Nutrients - phosphorus, nitrite/nitrate, and ammonia/un-ionized ammonia
- Biological - fecal coliforms and pathogens, and chlorophyll-a
- Physical parameters - pH, dissolved oxygen, conductivity, turbidity, oil and grease, temperature, and salinity)
- Other constituents - polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, sulfate, chloride, tributyltin (TBT), polychlorinated biphenyls (PCBs), and volatile organic compounds (VOCs).

Under Section 303(d) of the Clean Water Act (CWA), states are to develop Total Maximum Daily Loads (TMDLs) for water bodies not meeting designated standards under technology-based controls for pollution. For the C&SF project study area, over 160 priority waterbodies/segments were listed by FDEP. Of these waterbodies, 95 are listed in the Southeast Florida Basin, which includes WCAs and the Tamiami Trail project area. The primary constituents of concern are nutrients, dissolved oxygen (DO), mercury, biochemical oxygen demand (BOD), and coliforms. Canals bordering the WCAs generally have very low DO levels typical of marsh waters. Nutrient levels at the marsh perimeter are elevated, probably from the breakdown of organic debris as well as agricultural drainage. The key water quality problems in WCA-3A and 3B are total phosphorus (TP), DO, conductivity, mercury, and nitrite/nitrate nitrogen. For the period from 1979 to 1993, the mean TP concentration collected in the WCA-3A basin was 0.032 mg/l, while the mean concentration in the WCA-3B basin was 0.013 mg/l. For the period from 1979 to 1993, the mean DO concentration was 4.8 mg/l in WCA-3A and 3.7 mg/l in WCA-3B. From 1979 to 1993, the mean specific conductance value in WCA-3A was 718.4 μ mhos/cm and 686.4 μ mhos/cm in WCA-3B. Mercury bioaccumulation in Everglades water and biota is complicated by inter-relationships of several factors such as sulfate, sulfide, phosphorus, oxygen, carbon, peat chemical characteristics, biodegradation and aquatic food web structure. Table 1 shows recent results of analysis of water released from structures in the project area, S-355A&B, from WCA-3B to ENP.

Phosphorus and nitrogen are the most common nutrients that limit the growth of aquatic plants, and even small increases in concentrations can have significant ecological impacts. Phosphorus generally occurs in quite low concentrations (less than 0.01 mg/l) in unimpacted wetlands of southern Florida and at higher concentrations (median concentration of 0.06 mg/l) in the northern Everglades. The higher concentrations have been implicated in changes in wetland communities. The main source of phosphorus in agricultural areas includes commercial fertilizers and manure, livestock grazing, non-agricultural fertilization, and on-lot septic systems. Inorganic forms of phosphorus (orthophosphate) originate from a class of minerals known as apatites. These minerals are calcium phosphates exhibiting a low solubility and

Table 1. Water Quality Analysis of Stations 355A and B

Parameter	November 16, 1999		June 15, 2000	
	S355A	S355B	S355A	S355B
Color (cpu)	25	20	50	45
NH3 (ammonia nitrogen, mg/l)	0.082	0.083	0.160	0.269
NO2_NO3 (nitrate- nitrite, mg/l)	<0.004	<0.004	0.077	0.134
TKN (total Kjeldahl nitrogen, mg/l)	0.32	0.39	1.16	1.57
TP (total phosphorus, mg/l)	0.028	0.022	0.032	0.044
OP (ortho-phosphorus, mg/l)	<0.002	<0.002	0.016	0.020
TSS (total suspended solids, mg/l)	7	4	8	13
DO Field (dissolved oxygen, mg/l)	6.7	6.6	7.8	5.0
Field Conductivity (µmhos/cm)	240	260	360	510

Source: USACE, 2000.

existing in several forms in which the orthophosphate ions are generated via chemical weathering process. Erosion from agricultural lands is a major source of diffuse phosphorus transfer. This erosion is often associated with high rates of particulate phosphorus transfer from land to surface water bodies. Unlike nitrogen, phosphorus is not particularly mobile in soils; phosphate ions do not leach readily. Therefore, phosphorus in most agricultural watersheds is removed from soils via either crop uptake or erosion. However, the surface and subsurface composition of a given watershed can result in high contributions of phosphorus from shallow subsurface flow, particularly in watersheds dominated by limestone geology (Sharpley and Syers, 1979; Pionke *et al.*, 1996).

Extensive agricultural Best Management Practices implemented in the Everglades Agricultural Area in the past several years have reduced the phosphorus load leaving the Everglades Agricultural Area; however, this area remains a primary source of pollutants for the WCAs. Water moving south from Lake Okeechobee and the Everglades Agricultural Area is pumped into the WCA canals, effectively making these areas act as nutrient filters. The highly altered hydroperiod, resulting from the levees and pump operations, may exacerbate water quality conditions in the WCAs, as evidenced by a general degradation of water quality in the areas along the canals and adjacent to pump stations and by comparisons to conditions in the central portions of the basins. In the central Everglades, phosphorus concentrations entering ENP were lower in 1997 than the interim and long-term limits established by the 1992 Settlement Agreement (Walker, 1998). The Everglades Settlement Agreement (1991) specifies phosphorus limit as 11 ppb. Water quality data in the central Everglades indicate an average concentration of 13 ppb of phosphorus over a 13-year period (1983-1996). In order to predict future phosphorus concentrations and to design phosphorus removal models, inflow concentrations, mean depth, and hydraulic residence time are utilized as main parameters, and atmospheric deposition, seepage inflow, and seepage outflow are considered as secondary parameters (Walker, 1998).

A Surface Water Improvement Management (SWIM) Plan is being developed by SWFMD to resolve water quality issues in the Everglades Agricultural Areas and the

WCAs. If the goals of the SWIM Plan are accomplished, the threat posed by phosphorus loading from the agricultural areas would be eliminated. Thus, satisfactory water quality for the lower WCA-3B and ENP would be achieved.

In the past five years, while no significant trends in annual average mercury concentrations in water, sediment, or fish have been observed, mercury concentrations in fish tissue were high enough to warrant a no-consumption advisory for largemouth bass throughout most of the eastern two thirds of ENP and a recommendation of limited consumption for the southeast corner of ENP. The best water quality conditions in ENP were found in the central Shark River Slough (SRS) and along the coastal regions of the basin. The high concentrations of mercury in the biota are related to processes in the water and sediment that favor methylation of mercury and concentration of mercury in the Everglades food chain.

The most recent water quality study along Tamiami Trail was conducted by the U.S. Geological Survey (USGS), National Water-Quality Assessment Program in 1996-1997 and reported in 1999. This study covers 80-mile section of Tamiami Trail from Big Cypress Swamp to Everglades and 24-mile transect down SRS. The project area of interest is between miles 60 to 81 covering sampling stations at structures S-12-A to D, 5.3 miles east of S-12-D, and Bridge 870585. The report concluded that the quality of water along the Trail is spatially variable due to natural and human influences. Concentrations of chloride, sulfate, specific conductance and dissolved organic carbon tended to be relatively low in the undeveloped part of Tamiami Trail from the Turner River (mile 30.4) to about S-12-C (mile 66.6) and relatively high at the more developed west and east ends. Relatively high concentrations of these constituents occurred to the east of S-12-C due to the inflow of mineralized water from the northern Everglades through a network of canals. Twelve pesticides or pesticide degradation products were detected along the Tamiami Trail, with highest concentrations at Tomato Road in the west and S-12-D in the east where agricultural influences were greatest. Total phosphorus tends to decrease from west to east along the Trail. A more detailed discussion of this report is summarized below.

Specific conductance is a measure of the electrical conductivity of dissolved ions in water and provides a rough estimate of total dissolved solids (TDS) contributed by chloride, sulfide, other major ions, dissolved organic carbon, and silica. Specific conductance along the 80-mile section of the Tamiami Trail varied widely depending on location, season, upstream land use, and proximity to the coast. Specific conductance values were generally higher along the western Big Cypress Swamp and the Everglades sections of the Trail than in the central section. Higher specific conductance values in the Everglades are attributed to canal transport of mineralized water from the northern Everglades. The sources of the mineralized water include Lake Okeechobee; the Everglades Agricultural Area south of Lake Okeechobee; and naturally occurring, shallow, mineralized water beneath the northern Everglades (Parker *et al.*, 1955). Specific conductance values in SRS tended to decline slightly downstream of the S-12 structures.

Chloride concentrations along the Tamiami Trail show a U-shaped trend with the highest concentrations occurring near the west and east ends of the study area. Concentrations in the central section of the Tamiami Trail were typically about 10 to 30 mg/l

and increased to 40 mg/l or more in the western Big Cypress Swamp and the Everglades from about S-12-C and eastward. The higher concentrations of chloride in Everglades east of S-12-C, compared with concentrations in the central section, are due to the canal transport of mineralized water from the northern Everglades (Parker *et al.*, 1955). Like chloride, the plot of sulfate concentration across the Tamiami Trail is U-shaped. The higher concentrations in the western Big Cypress Swamp are due to the effects of seawater and the higher concentrations in the Everglades are due to the effects of mineralized water from the north. In the central section of the Tamiami Trail, most sulfate concentrations were quite low.

Concentrations of total phosphorus along the Everglades section of the Tamiami Trail and at sites in SRS were generally less than 0.01 mg/l, except for higher concentrations at S-12-D (0.030 mg/l) and at the headwaters of Rookery Branch (0.027 mg/l) in SRS. Across the gauged sections of the Trail, daily loads of TP and total Kjeldahl nitrogen (TKN), total organic nitrogen plus ammonia) were usually highest in the Everglades section through the S-12 structures. This was due more to the large flows from the northern Everglades than to high concentrations at the S-12 structures. The maximum daily loads for TP (57 kg) and TKN (6,300 kg) occurred at the S-12 structures during the rainy season in August 1997. Biomass and growth rate of periphyton (biological communities living on submerged surfaces such as rocks and aquatic plants) can provide indications of the availability of nutrients. The influence of water-column phosphorus on the biomass and growth rate of periphyton communities in Everglades has been addressed in a number of studies. Periphyton biomass accumulation rates were found to range from 0.09 to 0.9 g/sqm/d as ash-free dry mass (AFDM) and 0.05 to 1.0 mg/sqm/d as chlorophyll-a, which were comparable with rates at a low nutrient (TP of 0.011 mg/l) marsh site in northern Everglades reported by Swift and Nicholas (1987).

Dissolved organic carbon (DOC) is of ecological significance because it can (1) reduce the amount of light available for the growth of submerged aquatic plants, (2) serve as a source of carbon for bacterial growth, and (3) form complexes with trace elements (such as mercury) and make them more soluble and mobile in water. DOC concentrations near the Tamiami Trail ranged from 4.8 to 26.9 mg/l with a U-shaped trend similar to chloride and sulfate ions. Lowest concentrations of DOC occurred in the central section of the Tamiami Trail, and highest concentrations were at bridges 64 and 70 in the west and between S-12-B and culverts east of S-12-D.

Water samples collected along the Tamiami Trail were analyzed for mercury. While the highest value for total mercury (8.3 ng/l) occurred at Tomato Road (mile 6.8), all other values were within 1.4 and 3.7 ng/l. Concentrations of mercury in fish provides better time-integrated samples. The highest mercury concentration was detected in Florida gar (160 µg/l) at Loop Road. Largemouth bass from the L-67A Canal had a mercury concentration of 26 µg/l at L-67A Canal.

Herbicides are applied in agricultural and urban areas, sprayed directly into canals to kill nuisance aquatic weeds, and sprayed onto weeds and shrubs along the roadsides and canal banks. Pesticides can be detected at remote areas from the point of application due to their nature of transportation for long distances by air (Majevski and Capel, 1995). Along the Tamiami Trail, atrazine was the most frequently detected pesticide, followed by tebuthiuron, and metolachlor. The greatest numbers of

detections were at S-12-D and Tomato Road. Metolachlor exceeded the aquatic life criteria at S-12-D and Tomato Road. Fish and bottom sediments provide time-integrated samples of pesticide occurrence. DDT compounds were the only pesticides detected in fish at sampling sites including S-12 structures and L-67A Canal. DDT concentrations were ranged from 5 to 6 µg/kg in largemouth bass and 11 to 17 µg/kg in Florida gar.

The quality of surface water flowing southward in the Everglades and Big Cypress Swamp near an 80-mile section of the Tamiami Trail is spatially variable due to natural and human influences. The water quality characteristics suggest three distinct subsections along Tamiami Trail: the undeveloped center from Turner Road to about S-12-C, and the more developed western and eastern ends. Relatively high concentrations at the west end are due to agricultural and marine inputs, and at the east end are due to the inflow of mineralized water from the northern Everglades through a network of canals. Seasonal variations in water quality complicate the spatial variations in the area. Concentrations of many dissolved constituents and total phosphorus increase during the dry season due to the processes such as movement of seawater at the west, evapotranspiration, groundwater inflow, or the higher population of wildlife around the Tamiami Trail.

Highway Runoff. The definition of highway runoff differs among various investigators, and has been considered to either include or exclude contaminants from atmospheric deposition or runoff from sites adjacent to highways. Because the Tamiami Trail is rural and has a negligible amount of area within the Everglades for receipt of atmospheric deposition, the environmental effects of materials deposited on the highway from the atmosphere are considered insignificant. Only highway use by vehicles is considered.

Highway Runoff Characterization. Highway use results in the introduction of metals, fuels, lubricants, combustion products, and toxic chemicals as potential environmental contaminants. Table 2 summarizes several of the major constituents in runoff from highway use and their primary sources.

Table 2. Highway Runoff Constituents and Their Primary Sources

Constituents	Primary Sources
Lead	Leaded gasoline (exhaust), tire wear, lubrication, bearing wear
Zinc	Tire wear, motor oil
Iron	Rust, vehicle/engine wear
Copper	Metal plating, bearing/bushing wear, engine wear, brake wear
Cadmium	Tire wear, metal plating
Chromium	Metal plating, engine wear, brake wear
Nickel	Exhaust, lubricants, plating, brake wear
Organic compounds	Vehicle exhaust, fuel leaks, lubricants

Source: USEPA, 1993.

Organic compounds of relevance include semivolatile organic compounds (SVOCs) and volatile organic compounds (VOCs). Petroleum hydrocarbons, oil and grease, and polycyclic aromatic hydrocarbons (PAHs) in crankcase oil and vehicle emissions are the major SVOCs detected in highway runoff (Lopes and Dionne, 1998). VOCs include toluene, xylenes, and benzene, which are constituents of gasoline. The most significant factor affecting SVOC concentrations in suspended solids concentrations is that approximately 80 percent of SVOCs are associated with suspended solids (Lopes and Dionne, 1998). However, Lopes and Dionne (1998) noted that the regression analyses developed in the 1970s and 1980s are of limited use in estimating current loads of SVOCs because the recent use of cleaner fuels and the increased proportion of vehicles with catalytic converters have lowered release of SVOCs in vehicle exhaust. VOCs are more generally associated with urban stormwater, and their occurrence and concentrations are affected markedly by ambient temperature.

The concentration of pollutants in runoff is dependent on a number of factors, including the amount of traffic to which the road is subjected. Table 3 illustrates the differences in concentration of pollutants in highway runoff relative to vehicle usage.

Table 3. Pollutant Concentrations in Highway Runoff

Pollutant	Event Mean Concentration for Highways with Fewer than 30,000 Vehicles /Day* (mg/l)	Event Mean Concentration for Highways with More than 30,000 Vehicles /Day* (mg/l)
Total Suspended Solids	41	142
Volatile Suspended Solids	12	39
Total Organic Carbon	8	25
Chemical Oxygen Demand	49	114
Nitrite and Nitrate	0.46	0.76
Total Kjeldahl Nitrogen	0.87	1.83
Phosphate Phosphorus	0.16	0.40
Copper	0.022	0.054
Lead	0.080	0.400
Zinc	0.080	0.329

* Event mean concentrations are for the 50 percent median site.

Source: Driscoll, *et al.* (1990)

Effects of Highway Runoff on Wetland Biota. In general, highway runoff contains pollutants that have a potential to adversely affect species dependent on wetland habitat for all or part of their lifecycles, that can lead to the pollution of wetlands, and that can cause a decline of wetland values (Clairmont Graduate University and Rails-to-Trails Conservancy, 1998). However, documentation of adverse effects of highway runoff on aquatic organisms and communities does not provide a clear relationship. The effects of highway runoff on individual organisms, populations, and communities have been examined for over 25 years. However, there are data gaps, deficiencies in

study designs, and differences in geography, site characteristics, traffic counts, etc., associated with diverse objectives and monitoring goals. Granato, *et al.* (1998) expressed the need for data and procedures that are current, valid, and technically supportable. The Federal Highway Administration (FHWA) (1997) noted that: *The effects of highway runoff on wetlands is an area of concern and continued research. But here, too, we must update or inventory the pollutants that affect our wetlands today and our methods of quantifying those pollutants, and then we can see if highway runoff is a cause of pollution to wetlands. Studies to date indicate that highway runoff is not a significant source of wetland pollution.*

Effects of the different contaminants present in highway runoff depend on study location, environmental setting, and the characteristics of receiving waters. Cumulative effects on biological systems from highway-runoff quality include effects of all bio-available contaminants and any interactions among them (Buckler and Granato, 1999). Buckler and Granato (1999) concluded that different methods among studies and a general lack of sufficient documentation preclude quantitative comparisons among the various studies. They noted that, qualitatively, the literature indicates that constituents from highway runoff are found in the tissues of aquatic biota, and that the diversity and productivity of biological communities may be affected, even though bioassays would suggest that highway runoff is not often toxic to the aquatic biota. Different contaminants were stated by Buckler and Granato (1999) to have varying biological effects, depending on the physical and chemical properties of each constituent, the concentrations found in an environmental system, the sensitivities of organisms to the runoff, and the ability of the system, and individual organisms to assimilate the constituent(s).

Buckler and Granato (1999) reviewed the effects of highway runoff constituents on biota at the biochemical/physiological level, the whole-organism/species level, and the population/community level. The first interactions of contaminants with an organism occur at the biochemical/physiological level. Metals typically tend not to accumulate to the extent shown by organic compounds, but they are associated with a number of toxicological conditions, including interference with the regulation of metals and interference with biochemical pathways. PAHs can interfere with a number of biochemical pathways, including interference with reproduction.

At the whole organisms-species level, there have been numerous toxicity testing investigations on the effects on organisms by metals and organic compounds, such as those found in highway runoff. These have included algae assays, invertebrate assays, and toxicity studies of the early life stages of fishes. Assessments have included effects on survival, growth, and reproduction (Buckler and Granato, 1999). Corbett and Manner (1975) were reported by Buckner and Granato (1999) to have found that when compared to control sites, areas affected by highway runoff had fewer sensitive species of aquatic organisms.

The application of biodiversity assessments to highway runoff, while not fully developed, involves the attempt to determine the abundance and distribution of various species as indicators of population and community stress. Presence or absence, numerical abundance, and spatial distribution of indicator species are used to determine status. Functional analysis techniques focus on community respiration,

nutrient cycling, etc. Effects of contaminants have included spatial distribution of various components of the community, deformities, and community metrics (Buckler and Granato, 1999).

Typically, ecological effects of highway runoff quality on receiving waters have been predicted using statistical models of contaminant concentration and loadings. These predictive approaches, which compare concentrations and loadings to published regulatory limits, indicate that there should not be measurable effects at sites with annual average daily traffic (ADT) volumes with less than 30,000 vehicles per day (vpd) (Driscoll *et al.*, 1990). Smith and Kaster (1983) reported that along a rural highway with relatively low vehicle counts (7,000-8,000 vpd) disruptions of benthic macroinvertebrate communities were negligible. However, other biological studies have shown changes in individual organisms and community structures at sites with low traffic volumes (Buckler and Granato, 1999). Dupuis *et al.* (1985) reported that at some sites with low traffic volume (7,400 vpd), runoff caused no changes in abundance or distribution, but at other sites along the same highway there appeared to be effects.

Runoff from the Tamiami Trail. Because there are no known studies of the quality or quantity of runoff from the Tamiami Trail, the quality of the runoff and the effects to the Everglades ecosystem must be inferred. The ADT traffic volume along the Tamiami Trail, approximately 5,200 vpd, is quite low. Therefore, based on studies from other locations, it would be expected that the biological effects of the runoff would be minimal.

USGS water quality data have been collected from various locations along the Tamiami Canal since the 1940s (Figure 2). Among the data were concentrations of cadmium, chromium, copper, iron, lead, nickel, and zinc, all of which are constituents of highway runoff (Table 4). For most of the metals information, the database contained only the total fraction of the metals. Current *Florida Criteria for Surface Water Quality, Class III, Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife, Predominately Fresh Waters (Section 62-302.530, F.A.C.)* calls for metals to be expressed as the total recoverable fraction, which is a more restrictive criterion. Lead, which has largely been eliminated from highway runoff since its removal from gasoline, frequently exceeded water quality standards during the 1970s. A comparison of the historical data to the State Criteria showed that with the exception of lead, metals concentrations in the Tamiami Canal generally complied with water quality standards, with a rate of exceedance of approximately five percent. Similar results were found by Sullivan, *et al.* (1996).

There are potential sources of these metals in addition to highway runoff, such as airboat franchises and residential areas along the Tamiami Trail, and there is a potential for transport of metals from other locations by the network of canals. It appears that with the removal of lead from gasoline, runoff has little impact on the quality of water in the Tamiami Canal.

Table 4. USGS Water Quality Data for the Tamiami Trail and Florida Water Quality Criteria

USGS 02288900

Total Cadmium			Total Chromium			Total Copper			Total Iron		
Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)
9/8/72	1.69	0	3/25/70	330.37	0	9/8/72	18.26	0	4/26/70	<=1000	60
6/9/73	1.89	nd .0	5/13/70	371.74	10	10/17/75	19.26	6	9/8/72	<=1000	50
10/23/73	1.82	<2	9/25/70	294.90	0	1/7/76	17.73	<2	6/9/73	<=1000	40
5/23/74	2.11	nd .0	10/17/75	330.37	<20	4/8/76	18.26	<2	10/23/73	<=1000	140
5/8/75	1.92	nd .0	1/7/76	305.16	<20	7/28/76	19.73	<2	5/23/74	<=1000	2400
10/17/75	1.78	<2	4/8/76	313.98	<20	10/21/76	20.17	nd .0	5/8/75	<=1000	1900
1/7/76	1.65	2	7/28/76	338.04	20	1/25/77	19.73	2	10/17/75	<=1000	90
4/8/76	1.69	3	10/21/76	345.41	<20	4/13/77	16.57	3	1/7/76	<=1000	70
7/28/76	1.82	nd .0	1/25/77	338.04	<20	3/14/78	18.77	5	4/8/76	<=1000	1100
10/21/76	1.85	nd .0	4/13/77	286.00	<20	4/13/78	20.17	9	7/28/76	<=1000	120
1/25/77	1.82	nd .0	3/14/78	322.36	<20	7/13/78	17.73	<2	10/21/76	<=1000	50
4/13/77	1.55	2	4/13/78	345.41	<20	9/27/78	19.73	2	1/25/77	<=1000	50
9/7/77	1.65	nd .0	7/13/78	305.16	<20	10/24/78	19.26	<2	4/13/77	<=1000	430
3/14/78	1.73	nd .0	9/27/78	338.04	<20	1/17/79	20.61	nd .0	9/7/77	<=1000	70
4/13/78	1.85	2	10/24/78	330.37	<20	7/11/79	20.17	3	1/25/78	<=1000	70
7/13/78	1.65	7	1/17/79	352.51	20	10/17/79	18.26	2	3/14/78	<=1000	190
9/27/78	1.82	30	7/11/79	345.41	20	1/16/80	21.43	1	4/13/78	<=1000	180
10/24/78	1.78	11	10/17/79	313.98	20	4/9/80	20.17	2	7/13/78	<=1000	150
1/17/79	1.89	nd .0	1/16/80	365.97	20	7/11/80	18.77	3	9/27/78	<=1000	160
7/11/79	1.85	5	4/9/80	345.41	10	11/19/80	18.26	3	10/24/78	<=1000	200
10/17/79	1.69	0	7/11/80	322.36	<10	7/16/81	19.73	4	1/17/79	<=1000	100
1/16/80	1.96	0	11/19/80	313.98	30	12/1/81	21.82	7	7/11/79	<=1000	1100
4/9/80	1.85	0	7/16/81	338.04	20	7/18/82	18.77	10	10/17/79	<=1000	170
7/11/80	1.73	0	12/1/81	372.37	<10				1/16/80	<=1000	190

Table 4 (cont'd). USGS Water Quality Data for the Tamiami Trail and Florida Water Quality Criteria

USGS 02289900 (Cont'd)				Total Lead			Total Nickel			Total Zinc			Total Iron		
Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)		Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)		Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)		Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	
11/19/80	1.69	0		7/18/82	322.36	20		9/8/72	186.02	30		4/9/80	<=1000	210	
7/16/81	1.82	<1		6/9/73	273.27	4		1/7/76	180.46	30		7/11/80	<=1000	300	
12/1/81	1.99	<1		10/23/73	261.70	8		4/8/76	186.02	30		11/19/80	<=1000	680	
7/13/82	1.73	<1		5/23/74	308.33	16		7/28/76	201.26	30		7/16/81	<=1000	300	
9/8/72	6.08	0		5/8/75	278.75	<2		10/21/76	205.94	30		12/1/81	<=1000	260	
6/9/73	7.28	2		10/17/75	255.56	nd.0		1/25/77	201.26	<20		12/1/81	<=1000	260	
10/23/73	6.82	10		1/7/76	235.45	10		4/13/77	168.41	20		7/18/82	<=1000	270	
5/23/74	8.73	12		4/8/76	242.47	nd.0		3/14/78	191.32	20					
5/8/75	7.50	17		7/28/76	261.70	2		4/13/78	205.94	20					
10/17/75	6.58	14		10/21/76	267.59	nd.0		7/13/78	180.46	nd.0					
1/7/76	5.82	36		1/25/77	261.70	<2		9/27/78	201.26	20					
4/8/76	6.08	80		4/13/77	220.19	2		10/24/78	196.39	20					
7/28/76	6.82	5		3/14/78	249.17	6		1/17/79	210.45	nd.0					
10/21/76	7.05	2		10/17/79	242.47	0		7/11/79	205.94	60					
1/25/77	6.82	4		1/16/80	284.06	1		10/17/79	186.02	10					
4/13/77	5.26	13		4/9/80	267.59	0		1/16/80	219.03	20					
9/7/77	5.82	12		7/11/80	249.17	1		4/9/80	205.94	20					
3/14/78	6.33	24		11/19/80	242.47	6		7/11/80	191.32	10					
4/13/78	7.05	30		7/16/81	261.70	6		11/19/80	186.02	20					
7/13/78	5.82	120		12/1/81	289.19	2		7/16/81	201.26	20					
9/27/78	6.82	600		7/18/82	249.17	2		12/1/81	223.12	50					
10/24/78	6.58	140						7/18/82	191.32	20					
1/17/79	7.28	50													
7/11/79	7.05	4													
10/17/79	6.08	1													
1/16/80	7.72	4													
4/9/80	7.05	2													
7/11/80	6.33	0													
11/19/80	6.08	12													
7/16/81	6.82	8													
12/1/81	7.93	3													
7/18/82	6.33	5													

Table 4 (cont'd). USGS Water Quality Data for the Tamiami Trail and Florida Water Quality Criteria

USGS 02289018

Total Cadmium			Total Chromium			Total Copper			Total Iron		
Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)
4/26/72	1.65	1	5/27/69	329.59	0	4/26/72	180.46	0	5/27/69	<=1000	0.13
10/3/72	1.65	nd .0	5/13/70	324.80	0	10/3/72	180.46	nd .0	9/25/70	<=1000	160
6/9/73	2.05	nd .0	9/25/70	291.01	0				4/26/72	<=1000	330
5/23/74	1.99	<2	10/3/72	305.16	nd .0				10/3/72	<=1000	400
4/19/76	1.89	2							6/9/73	<=1000	20
4/13/77	1.69	nd .0							5/23/74	<=1000	630
10/12/77	1.60	nd .0							4/19/76	<=1000	210
									4/13/77	<=1000	290
									10/12/77	<=1000	220
Total Lead			Total Nickel			Total Zinc					
Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)			
4/26/72	5.82	0	6/9/73	273.27	4	4/26/72	180.46	10			
10/3/72	5.82	2	5/23/74	308.33	16	10/3/72	180.46	<20			
10/23/73	6.82	10	4/19/76	273.27	nd .0						
6/9/73	8.34	12	4/13/77	242.47	<2						
5/23/74	7.93	17	10/12/77	228.04	nd .0						
4/19/76	7.28	14									
4/13/77	6.08	36									

Table 4 (cont'd). USGS Water Quality Data for the Tamiami Trail and Florida Water Quality Criteria

USGS 02289040

Total Cadmium				Total Chromium				Total Copper				Total Lead			
Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)		Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)		Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)		Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	
10/16/72	1.60	<2		6/27/69	272.18	0		10/30/73	18.77	3		10/16/72	5.82	7	
10/30/73	1.73	9		7/28/69	290.02	0		4/15/74	22.57	5		4/16/73	8.53	3	
4/15/74	2.05	nd .0		1/26/70	298.71	0		10/30/74	18.26	<2		10/30/73	6.33	2	
10/30/74	1.69	<20		10/16/72	295.86	30		4/30/75	21.43	2		4/15/74	8.34	9	
4/30/75	1.96	nd .0		10/30/73	322.36	nd .0						10/30/74	6.08	nd .0	
				4/15/74	384.82	nd .0						4/30/75	7.72	3	
				10/30/74	313.98	<20									
				4/30/75	365.97	<20									
Total Zinc															
	Water Quality Criteria (UG/L)	Sample Result (UG/L)													
7/28/69	170.93	10													
10/30/73	191.32	30													
4/15/74	230.95	<20													
10/30/74	186.02	30													
4/30/75	219.03	5													

Table 4 (cont'd). USGS Water Quality Data for the Tamiami Trail and Florida Water Quality Criteria

USGS 02289040

Total Cadmium			Total Chromium			Total Copper			Total Iron		
Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)
10/17/72	2.02	nd .0	4/16/73	407.19	nd .0	10/30/73	22.57	2	10/6/53	<=1000	0.13
10/30/73	2.05	3	10/30/73	384.62	<2	4/15/74	23.62	2	11/25/53	<=1000	0.28
4/15/74	2.14	nd .0	4/15/74	401.76	<20	10/30/74	23.95	<2	12/28/53	<=1000	0.17
10/30/74	2.17	nd .0	10/30/74	407.19	<20	4/30/75	24.91	nd .0	2/11/54	<=1000	0.18
4/30/75	2.25	nd .0	4/30/75	422.74	<20	4/25/78	22.93	4	3/12/54	<=1000	0.09
4/25/78	2.08	nd .0	4/25/78	390.49	<20	10/16/78	23.95	2	4/20/54	<=1000	0.59
10/16/78	2.17	nd .0	10/16/78	407.19	<20	10/16/79	22.20	3	5/18/54	<=1000	0.19
10/16/79	2.02	0	10/16/79	378.59	30				6/23/54	<=1000	0.02
									7/29/54	<=1000	0.52
Total Zinc			Total Lead			Total Nickel					
Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)	Date	Water Quality Criteria (UG/L)	Sample Result (UG/L)			
10/30/73	230.95	30	10/17/72	8.13	7	4/25/78	303.74	7	8/18/54	<=1000	0.51
4/15/74	241.94	20	10/30/73	8.94	25	10/16/78	317.17	4	10/1/54	<=1000	0.07
10/30/74	245.42	<20	4/15/74	8.92	10	10/16/79	294.18	0	11/10/54	<=1000	0.03
4/30/75	255.42	nd .0	10/30/74	9.11	nd .0				12/16/54	<=1000	0.03
4/25/78	234.70	20	4/30/75	9.65	9				1/12/55	<=1000	0.02
10/16/79	227.09	10	4/25/78	8.53	nd .0				3/15/55	<=1000	0.02
			10/16/79	8.13	2				4/13/55	<=1000	0.18
									8/16/72	<=1000	860
									10/17/72	<=1000	730
									1/8/73	<=1000	710
									4/16/73	<=1000	680
									7/15/73	<=1000	280
									10/30/73	<=1000	950
									1/16/74	<=1000	50
									4/15/74	<=1000	670
									10/30/74	<=1000	810
									4/30/75	<=1000	380
									4/25/78	<=1000	950
									10/16/78	<=1000	870
									5/14/79	<=1000	490
									10/16/79	<=1000	1300

2.3.2 Groundwater

South Florida contains three major carbonate aquifer systems. The surficial aquifer system is comprised of rocks and sediments from the land surface to the top of an intermediate-confining unit. The discontinuous and locally productive water bearing units of the surficial aquifer include the Biscayne Aquifer, the undifferentiated surficial aquifer, the coastal aquifer of Palm Beach and Martin Counties and the shallow aquifer of southwest Florida. Practically all municipal and irrigation water is obtained from the surficial aquifer system. The intermediate aquifer system consists of beds of sand, sandy limestone, limestone and dolostone that dip and thicken to the south and southwest. In much of south Florida, the intermediate aquifer represents a confining unit that separates the surficial aquifer system from the Floridan aquifer system. The Floridan aquifer system is divided by a middle confining unit into the Upper and Lower Floridan aquifers. In the Lower East Coast, from Jupiter to south Miami, the Upper Floridan aquifer is being considered for storage of potable water in an aquifer storage and recovery program. The Floridan aquifer system is one of the most productive aquifers in the world and is a multiple-use aquifer system. In the Lower Floridan aquifer, there are zones of cavernous limestones and dolostones with high transmissivities. Because these zones contain saline water, they are not used for drinking water supply and are used primarily for injection of treated sewage and industrial wastes. Where the aquifer contains fresh water, it is the principal source of water supply.

Groundwater in the surficial Biscayne aquifer and the Floridan aquifer are both critical to the ecology and economy of south Florida. The Biscayne aquifer has been classified as a Sole Source Aquifer under the Federal Safe Drinking Water Act based on the aquifer's susceptibility to contamination and the fact that it is a principal source of drinking water. Well fields in this aquifer can generally yield in excess of 2,000 gal/min. Because the Biscayne Aquifer is highly permeable and is at or near the land surface in many locations, it is readily susceptible to groundwater contamination. Well fields in the aquifer can be recharged rapidly and effectively from the Water Conservation Areas and the coastal canal system. Major sources of groundwater contamination are saltwater intrusion and infiltration of contaminants carried in canal water.

Saltwater intrusions into the North Central Miami-Dade County water supply come primarily from the tidally influenced canal system and pumpage from the Hialeah-Miami Springs and Northwest Well Fields. In South Florida, uncontrolled discharge from an estimated 6,500 abandoned wells that tap the brackish waters of Floridan aquifer system caused discharge of 359 mgd of saline water into freshwater aquifers. Two possible sources of saltwater into the well fields are nearby tidal reaches of the Miami and Tamiami Canals and the coastal interface. Another source of saltwater is residual seawater trapped in the aquifer during deposition because of high sea levels during interglacial periods or effects of storm tides. Additional sources of groundwater contamination include direct infiltration of contaminants, such as chemicals or pesticides applied to or spilled on the land, or fertilizers carried in surface runoff; leachate from landfills, septic tanks, sewage-plant treatment ponds; and wells used to dispose of storm water runoff or industrial waste.

Most disposal wells discharge into aquifers containing saltwater that underlie the Biscayne aquifer, but they are a potential source of contamination where they are improperly constructed. Numerous hazardous waste sites (e.g., Superfund and Resource Conservation and Recovery Act [RCRA] sites) have been identified in the area underlain by the Biscayne aquifer. Superfund sites can contribute to groundwater quality degradation through the leaching of site pollutants into groundwater, as well as to surface water quality degradation through storm water runoff. Miami-Dade County currently has seven National Priority List (NPL) ("Superfund") sites. Although each site poses unique environmental threats, trichloroethylene (TCE) and vinyl chloride are generally identified as common contaminants of concern in groundwater at these sites. Both of these organic compounds are carcinogens associated with degreasing agents that have enforceable drinking water standards (3 ppb for TCE and 1 ppb for vinyl chloride). The RCRA facilities that treat, store, and/or dispose (TSDs) of hazardous waste may contribute to groundwater contamination through past spills and poor waste management practices resulting in the leaching of pollutants into the subsurface. Miami-Dade County currently has four RCRA TSDs. As with Superfund sites, though each facility presents unique environmental threats, Non-Aqueous Phase Liquids (NAPLs) and TCE and its daughter products, particularly vinyl chloride, are of greatest concern with respect to groundwater contamination. This is due to the prevalence of these contaminants, the difficulty of remediating and preventing further degradation of the groundwater, and the toxicological effects of the contaminants.

2.4 HAZARDOUS, TOXIC, OR RADIOLOGICAL WASTE

The hazardous, toxic, or radioactive waste (HTRW) preliminary assessment indicated that in general, no evidence of HTRW exists within the project area. During project construction, further HTRW awareness should be practiced.

The HTRW database review (Figure 3) indicated that no contamination exists along Tamiami Trail within the project area. Evidence of a leaking underground storage tank (UST) was found on the western boundary of the project area. However, based upon information available at this time, it does not appear to pose a risk to the project area because the UST was upgraded in 1999 and associated contaminates remediated.

2.5 ENVIRONMENTAL RESOURCES

The historic Everglades was a broad, shallow wetland flowing very slowly over 3,900 square miles from Lake Okeechobee to the mangrove zone at the southern tip of Florida. The sheetflow that naturally occurred over this region was influenced by rainfall and the land's relatively small surface relief. Sheetflow provided the necessary conditions for the development of the natural Everglades ecosystem that consisted of numerous animal and plant species.

The portion of the Tamiami Trail within the project area is bordered by important ecological areas such as ENP and NESRS to the south and WCA-3B to the north. Other important environmental resources near the project area include unique flora and fauna and threatened and endangered species. The following subsections describe the existing conditions of environmental resources that may be affected by the project.

2.5.1 Everglades National Park (ENP)

Recognized by the U.S. Congress as a nationally and internationally significant resource, ENP lies at the southern extremity of the Everglades and below the south end of the C&SF Project. In addition to recognizing ENP as a significant resource, the Everglades National Park Protection and Expansion Act of 1989 (Public Law 101-229) authorized the acquisition of land to benefit the natural resources of ENP. The Act was to:

...increase the level of protection of the outstanding natural values of Everglades National Park and to enhance and restore the ecological values, natural hydrologic conditions, and public enjoyment of such area...

In accordance with the Act, the Department of Interior, National Park Service (NPS) has identified lands for incorporation into ENP. Because the ENP "possesses outstanding universal value", it has been designated A World Heritage Site by the United Nations. These lands include historic Everglades that have had limited manmade influences and for the most part, avoid agricultural land. Within the project area, several commercial properties south of the Tamiami Trail are currently being acquired as a result of the Everglades National Park Protection and Expansion Act of 1989.

ENP provides habitat for approximately 25 terrestrial and two aquatic species of mammals. The avian fauna of ENP is especially rich; over 300 species of birds have been identified. The U. S. Fish and Wildlife Service has identified 16 species of animals Federally listed as threatened or endangered under the Endangered Species Act. South Florida's location makes it a migratory crossroads for West Indian and Central and South American birds while numerous North American species are residents. The majority of this continent's species of wading birds, shorebirds, and waterfowl are found within ENP during different times of the year. One of the key reasons for the establishment of ENP was to protect the nesting areas and feeding grounds of wading birds such as herons, egrets, ibis, wood stork, and roseate spoonbill.

The reptiles and amphibians of the region include two species of crocodilians, three or four species of salamanders, 6 species of lizards, 10 species of land and freshwater turtles, five species of sea turtles, 12 species of frogs, and 23 species of snakes. The waters of the Everglades and ENP support a large variety of fish in both freshwater and estuarine habitats. Fish provide a major part of the diet of most of the other vertebrate animal inhabitants.

The historic wetlands communities of the southern Everglades included sawgrass marshes, sloughs (with aquatic plants), marsh (marl) prairies, tree islands with bay forests, and cypress forests. Upland communities include Miami rockland pine forests, and hammock forests, both in the pinelands and as tree islands surrounded by wetland vegetation. A gradient of water conditions and associated hydroperiods exist among these communities. Most of the historic wetland communities exist at present, although changes have occurred in the species composition, structure, and spatial distribution of some communities as a result of altered water conditions.

2.5.2 Shark River Slough East and West Basins

SRS is the southern, relatively deep, Everglades flow-way entering ENP from the north and flowing across ENP to Florida Bay. The seasonal expansion and contraction of water supply to SRS provides the dynamic pulses of aquatic and semiaquatic plants and animals.

2.5.3 Water Conservation Area 3B

WCA-3B, located to the north of the L-29 Levee for the entire length of the project, is managed by Florida Fish and Wildlife Conservation Commission (FWC) as the Francis S. Taylor Wildlife Management Area. WCA-3B is dominated by a generally unimpacted wetland sawgrass community and has historically been used to assist in the management of water levels and flow quantities. The area provides nesting and foraging habitat for a variety of terrestrial and aquatic species including the Federally endangered snail kite. Tree islands present in the area are extremely important habitats for a wide variety of terrestrial and semi-aquatic wildlife.

FWC-8

FWC-9

2.5.4 Biological Communities

Historically, the eastern Everglades was a mosaic of wet prairies, varying in surface elevation, hydroperiod, and vegetation type. Residential, commercial, and industrial developments, as well as agriculture, have altered portions of the Everglades. The project area is bordered to the north by WCA-3B and to the south largely by ENP, which are mostly natural areas with long and short hydroperiod wetlands with an abundance of interspersed willowheads, bayheads, and hardwood hammocks. Sawgrass (*Cladium jamaicense*) communities dominate the long hydroperiod wetlands while muhly grass (*Muhlenbergia capillaris*) and black sedge (*Schoenus nigricans*) dominate the short hydroperiod wetlands mostly influenced by NESRS and local rainfall. There are four herbaceous wetland cover types in the Everglades: (1) sloughs with deep, permanent water levels, (2) sawgrass marshes with semi-permanent water levels and long hydroperiods, (3) wet peat prairies, and (4) wet marl prairies with shorter hydroperiods. These are characterized by the average flooding depth and the duration of the flooding period, and by their predominant plant cover.

SFWMD prepared a comprehensive vegetation cover map that includes the project area (Figure 4). Vegetation communities present along the portion of the Tamiami Trail in the project study area include swamp forest bayheads (*Magnolia virginiana*, *Annona glabra*, *Chrysobalanus icaco*, *Persea borbonia*, *Ilex cassine*, *Metopium toxiferum*, among others), maidencane/spike-rush (mix of shallow open water, *Eleocharis* spp. and *Panicum hemitomon*, which can include sparse association of low-stature *C. jamaicense*, *Typha* spp., *Sagittaria lancifolia*, *Pontederia lanceolata*, *Nymphaea* spp., etc. typical of SFWMD impounded conservation areas), graminoid (grasses, sedges, and rushes), non-graminoid emergent marsh (*P. lanceolata*, *Sagittaria* spp., *Nymphaea odorata*, *Typha* spp., with *Ludwigia repens* and *Utricularia* spp. as possible submergents), saw grass (*C. jamaicense*), cat-tail (*Typha* spp.), scrub hardwood (species such as *M. toxiferum*, *P. borbonia*, *Myrica cerifera*, *I. cassine*, *M. virginiana*, *Myrsine floridana*, *Conocarpus erectus*, *C. icaco*, and others, often with a moderate-to-heavy component of mixed grasses) and willow shrublands (*Salix caroliniana*). Other

classifications along the Tamiami Trail include open water, spoil areas, areas influenced by human activities, major roads, and canals.

2.5.5 Threatened or Endangered Species

A variety of species listed as threatened, endangered, or of special concern occurs or potentially occurs in the study area. Preliminary coordination with FWC showed that there are known wading bird rookery sites within two miles of the highway within the project corridor (Figure 5). These rookeries have supported nesting efforts by the wood stork (federally endangered), snowy egret, tricolored heron, little blue heron, and white ibis (Florida Species of Special Concern). Nest initiation by the wood stork has begun as early as February, with the initiation of nesting by the other species of special concern beginning as early as March. Nesting activities in these rookeries usually lasts until the rains have dispersed prey, leading to the cessation of nesting.

Federally listed species which are known to occur or could occur in the action area or be affected by construction and operation of the action include: the endangered snail kite (*Rostrhamus sociabilis*), wood stork (*Mycteria americana*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), and the threatened eastern indigo snake (*Drymarchon corais couperi*). In a letter dated October 18, 2000, FWCFWC identified six avian species of special concern that may nest or otherwise be found in the vicinity of Tamiami Trail between S-334 and the L-67s: tricolored heron, snowy egret, little blue heron, limpkin, roseate spoonbill, and white ibis. In addition, the snail kite and wood stork are also listed by FWC as endangered. The American alligator (a species of special concern) and the Everglades mink (listed as threatened) also are found along the Tamiami Trail corridor.

- **Snail Kite (*Rostrhamus sociabilis plumbeus*).** Snail kites, listed as endangered in 1967, require long hydroperiod wetlands that remain inundated throughout the year. This preference is associated with the apple snail (*Pomacea paludosa*), its primary food source, which requires nearly continuous flooding of wetlands for greater than one year. Suitable habitat for the kite includes freshwater marsh and shallow vegetated lake margins where apple snails can be found. Critical habitat for the snail kite was designated in 1977 and includes WCA-1, 2, and 3A, and portions of ENP, as well as Lake Okeechobee shorelines and portions of the St. Johns marsh. Preferred nesting habitat includes small trees and shrubs such as willow, bald cypress, pond cypress, sweet bay, dahoon holly, southern bayberry, and elderberry. During dry periods when suitable shrubs and trees experience dry conditions, herbaceous species such as sawgrass, cattail, bulrush, and common reed are used for nest sites. The breeding season can vary from year to year depending on rainfall and water levels. Ninety-eight percent of nesting attempts occur from December through July with 89 percent initiated between January and June.
- **Wood Stork (*Mycteria americana*).** The wood stork was listed as endangered in 1984 due to loss of foraging habitat and colony nesting failures. Preferring freshwater wetlands for nesting, roosting, and foraging, wood storks can be found throughout central and southern Florida. Nests are typically constructed in tree stands within swamps or stands surrounded

by large areas of open water. Due to its tactile feeding methods, storks feed most effectively in shallow water settings where prey items are concentrated. During the winter and spring dry seasons, when water levels recede, prey items are often further concentrated, providing foraging areas with abundant food supplies. Drainage in southern Florida may be responsible for delayed nesting by the stork, moving from an early nesting start in November to February or March. Initiation of nesting this late is believed to contribute to nest failures and colony abandonment due to the dispersal of prey items associated with the onset of the wet season (May-June). There is no designated critical habitat for the wood stork.

- **Indigo Snake (*Drymarchon corais couperi*).** The indigo snake was listed as threatened in 1979 due to the loss of habitat associated with farming, construction, forestry, and other land use conversions, as well as over-collecting for the pet trade. The snake is a large, non-venomous docile species, which seems to be strongly associated with high, dry, well-drained sandy soils typically inhabited by the gopher tortoise. The indigo snake will frequent streams, swamps, and sometimes flatwoods in the warmer months. Gopher tortoise burrows and other subterranean caverns are used for dens and laying eggs. The home range of the indigo snake varies considerably depending on the season and based on studies has a average winter range of 4.8 hectares, 42.9 hectares during the spring or early summer, and 97.4 hectares during late summer and fall.

The USFWS and FWC issued separate Coordination Act Reports (CARs) that document potential impacts to biological resources. Copies of the USFWS and FWC CAR are included in appendices I and J, respectively.

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2.5.6 Wetlands

The majority of the project is dominated by wetlands to the north and south of the Tamiami Trail. WCA-3B is adjacent to the project area to the north, and ENP lands abut the project area to the south. Wetlands to the north in WCA-3B begin immediately north of the L-29 Levee, and wetlands associated with the ENP begin immediately south of the Tamiami Trail. There are several small areas classified as non-wetlands south of the Tamiami Trail in private ownership, which constitute fill placed in wetlands.

Dominant wetland communities adjacent to the project area, as mapped by the SFWMD include:

- sawgrass
- cattail
- broadleaf and floating emergents
- cattail/sawgrass
- mix of shallow open water
- shrubland mix
- pond apple/willow mix
- Brazilian pepper/shrubland mix

2.6 CLIMATE

The subtropical climate of South Florida, with distinct wet and dry seasons, high rates of evapotranspiration, and climatic extremes of floods, droughts, and hurricanes represents a major physical driving force that sustains the Everglades while creating water supply and flood control issues in the agricultural and urban segments. Temperatures are moderated by the Atlantic Ocean and Gulf Stream, but the moderating effects quickly diminish inland. The average temperature is 68° F in winter and 82° F in summer. Seasonal rainfall patterns in south Florida resemble the wet and dry season patterns of the humid tropics more than the winter and summer patterns of temperate latitudes. Of the 53 inches of rain that south Florida receives annually on the average, 75 percent falls during the wet season months of May through October. During the wet season, thunderstorms that result from easterly tradewinds and land-sea convection patterns occur almost daily. The prevailing wind is from the east-southeast. Wet season rainfall follows a bimodal pattern with peaks during May-June and September-October. Tropical storms and hurricanes also provide major contributions to wet season rainfall with a high level of interannual variability and low level of predictability. During the dry season, rainfall is governed by large-scale winter weather fronts that pass through the region approximately weekly. High evapotranspiration rates in South Florida roughly equal annual precipitation. Recorded annual rainfall in South Florida has varied from 37 to 106 inches, and interannual extremes in rainfall result in frequent years of flood and drought. Multi-year high and low rainfall periods often alternate on a time scale approximately on the order of decades.

2.7 AIR QUALITY

In accordance with the Code of Federal Regulations Part 81, November 6, 1991, and with the 1990 Clean Air Act Amendments (CAAA), the USEPA designated the Southeast Florida Airshed, consisting of Miami-Dade, Broward, and Palm Beach counties, as nonattainment for the air pollutant ozone and its precursors. On April 25, 1995, the airshed was redesignated as attainment for ozone and is currently classified as an air quality maintenance area. Miami-Dade County is an attainment area for carbon monoxide. Nitrogen dioxide, sulfur dioxide, and total suspended particulates are present at concentrations that are better than national standards. EPA has not made a designation for airborne lead in southeastern Florida.

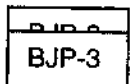
2.8 RECREATION

The Airboat Association of Florida is a recreational association whose site is located on the south side of the highway about three miles east of the western end of the project area. Facilities include a caretaker's house and storage structures for airboats belonging to members.

Three tourist-oriented businesses located on the south side of Tamiami Trail in the study area offer airboat trips, souvenirs, and restaurant facilities. The particular attraction of the businesses is ecotourism, *i.e.*, guided airboat tours into ENP with explanations about the nature of the Everglades as an ecological area, and information on some of the plants and animals. According to the owners/managers of the businesses, approximately 90 percent of all visitors who stop do so in order to inquire about or take

the airboat tours. (Personal communication-business owners/managers, multiple dates, 2000.)

Primary access to boat ramps on the north side of the L-29 Canal is provided by the S-333 and S-334 water control structures, which control the east-west flow in L-29 and mark the ends of the study area. Roads across these structures allow access to several boat ramps and to bank fishing on the north bank of L-29 Canal. S-334 provides access to an airboat ramp located at the structure and to a boat ramp (Boat Ramp 153) three miles to the east. The airboat ramp allows entrance into WCA-3B; the boat ramp allows boat launching into the L-29 Canal. There is a picnic area associated with the boat ramp. Control structure S-333 provides access across L-29 Canal to one airboat ramp and two boat ramps. And there is one boat ramp each on canals 67-A and 67-C. The S-333 structure also provides access to the Flight 592 memorial site. The 67-A and 67-C canals are heavily used by boat fishermen. The airboat ramps provide access to deer and waterfowl hunters as well as to recreational airboaters. There are approximately 10.5 miles of the north bank of the L-29 Canal available for bank fishing.



Bank fishing is popular from the shoulders of the Tamiami Trail. Fishermen frequent the 10.7 miles of the south bank of the L-29 Canal (north shoulder of the Trail) and at points along the south shoulder of the highway where culverts discharge water passing under the highway.

FWC personnel conducted angler counts along the Tamiami Trail from December 1998 to May 1999. The mean number of anglers per mile for weekdays and weekend days respectively was 0.95 and 2.28 respectively. Ninety-four percent were bank anglers. (Personal communication, FWC, September 28, 2000) These numbers would translate into an estimated 10 fishermen per weekday and 23 per weekend day, totaling approximately 5,000 man-days of fishing per year within the 10.7-mile study area extent. Personal observation showed 25 bank fishermen and two boats with two fishermen in the project study segment at approximately 10:00 AM on a Saturday in September 2000. Almost all the bank fishermen were fishing on either side of the highway right-of-way, with only a few on the north bank of the L-29 Canal.

2.9 CULTURAL RESOURCES

Studies for historic and archaeological resources were designed and implemented to comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended) as implemented by 36 CFR 800 (*Protection of Historic Properties*), Chapter 267 of the *Florida Statutes*, Section 4(f) of the Department of Transportation Act of 1966, and the minimum field methods, data analysis, and reporting standards embodied in the Florida Division of Historical Resources (FDHR) *Historic Compliance Review Program* (November 1990, final draft). In addition, the results presented herein were prepared in conformity with standards set forth in Part 2, Chapter 12 (*Archaeological and Historic Resources*) of the FDOT *Cultural Resource Management Handbook* (December 1995), the Florida Archaeological Council (FAC), and the Register of Professional Archaeologists (ROPA). All work performed to date conforms to professional guidelines set forth in the Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716). The objective of the cultural resources survey was to assess all cultural resources within the project's area of

potential effect for listing in the National Register of Historic Places according to the criteria set forth in 36 CFR 60.4.

Cultural resource specialists conducted a literature search and site file review to identify previously recorded sites and obtain cultural, historical, and environmental information about the project area. Research consisted of a review of the Florida Master Site File, the list of Historic Sites designated by the Miami-Dade Historic Preservation Board, and the Miami-Dade County Historic Survey. It should be noted that the site files reflect listings current to 1998. Additionally, books, maps, and other historic and archaeological literature were reviewed for information relating to the project area and its general vicinity. The results of this research and the use of environmental variables were used to develop site probability zones to assess the project area's potential to contain cultural resources.

The archaeological survey consisted of surface inspections, subsurface testing, and judgmental shovel tests. Shovel tests were placed at 25-, 50-, or 100-m (82-, 164-, or 328-ft) intervals for high, moderate, and low site probability zones, respectively. Judgmental shovel tests were placed within low probability zones and in areas deemed likely to contain archaeological resources. The historic resources survey used standard field methods to identify and record historic resources. All resources within the Area of Potential Effect (APE) received a preliminary visual reconnaissance. Any resource with features indicative of 1950s or earlier construction materials, building methods, or architectural styles were noted on aerial photographs and a USGS quadrangle map.

The reconnaissance and cultural resource assessment surveys were conducted to assess National Register-listed or potentially eligible resources that could be impacted by the improvement project. The findings of the study are presented in a report entitled Cultural Resource Assessment Survey for the Tamiami Trail Project Area (November 2000). The eligibility assessments presented in the report have been coordinated with the Florida State Historic Preservation Office (SHPO).

The cultural resource assessment survey conducted for the area of potential effects of the Tamiami Trail project area resulted in the identification of three sites considered potentially eligible for listing in the National Registry of Historic Places (NRHP). Table 5 lists the three resources considered potentially eligible (see Figure 6).

**Table 5. Sites Potentially Eligible for Listing In the
National Registry of Historic Places**

Site Name/Address	Site No.	NR Eligibility Status
Tamiami Trail	8DA6765	Potentially Eligible
Tamiami Canal	8DA6766	Potentially Eligible
Coopertown Airboat Rides & Restaurant 22700 Tamiami Trail	8DA6767	Potentially Eligible

Source: Janus Research, Inc., 2000

Section 2.0 – Existing Conditions/Affected Environment

The Airboat Association of Florida site is not included in this list. Although the Airboat Association of Florida building remains in good condition, its common design and building materials limit its significance. Based on a lack of significance this resource (8DA6768) is considered ineligible for listing in the NRHP.

- **Tamiami Trail.** The portion of the Tamiami Trail that is located in the project area traverses through Township 54 South, Ranges 37 and 38 East, and Sections 7 through 12. The overall Tamiami Trail is 245 miles in length, and the Miami-Dade County portion is approximately 24 miles in length. Although the roadway has experienced changes over the years, such as the paving of the original limerock road with asphalt, slight widening of the road, and the addition of low metal barriers on both sides of the road, the Tamiami Trail continues to retain its historic character. Additionally, the road's historic feeling, association, design, and setting are still evident. Based on its associations with the developmental, commercial, and transportation history of Florida and Miami-Dade County, the Miami-Dade County segment of the Tamiami Trail, including the portion within the project area, is considered a significant historic resource. The Tamiami Trail also maintains importance as one of the state's major engineering projects during the early 20th century. The portion of the Tamiami Trail located within the project area, as part of the Miami-Dade County segment of the Trail, is considered potentially eligible for listing in the NRHP in the areas of Transportation and Engineering.
- **Tamiami Canal.** The portion of the Tamiami Canal that is located in the project area traverses through Township 54 South, Ranges 37 and 38 East, and sections 7 through 12. The Tamiami Canal is considered significant based on its connection with the development of the Tamiami Trail and its role in the development of South Florida. Because it is an example of an early water management system, it has engineering significance. The Tamiami Canal's history is inextricably connected with the construction of the Tamiami Trail. During the construction activities for the roadway, dredging formed the Tamiami Trail and the Tamiami Canal located directly north of the highway. Throughout its history, the canal has served as a transportation corridor for local Native Americans and provided drainage for the roadway and surrounding area.

The portion of the Tamiami Canal located within the project area, as part of the Miami-Dade County segment of the canal, is considered potentially eligible for listing in the NRHP due to its link with the history of the significant Tamiami Trail and its importance to Florida and Miami-Dade County.

- **Coopertown Airboat Rides and Restaurant/22700 Tamiami Trail.** Located on the south side of the Tamiami Trail, the one-story frame vernacular restaurant and residence was constructed in 1947 by Coopertown's original owner, John Cooper. According to several sources, the current location of Coopertown was historically a Seminole camp that was perhaps inhabited by a Native American known as Jimmy Osceola. The property was also used as a work camp in the 1920s during the construction of the Tamiami Trail. Following World War II, Florida gained popularity as a vacation destination, and the history of the complex began when the Tamiami

Trail served as one of the main east-west travel routes for tourists and the transportation of goods across the state.

Coopertown Airboat Rides and Restaurant is significant based on its importance in tourism and community planning and development. This historic resource represents not only the heritage of tourist attractions along the Trail, but also illustrates Florida's long history as a destination for tourists. Within the Miami-Dade County portion of the Tamiami Trail, Coopertown is the oldest continuously operating airboat tour business. Based on its historical associations with the development of the area and its important contributions to tourism in the region, the Coopertown Airboat Rides and Restaurant complex is considered potentially eligible for listing in the NRHP in the areas of Entertainment/Recreation and Exploration/ Settlement.

2.10 AESTHETICS

The views afforded motorists traversing the project segment of the Tamiami Trail are interesting, but somewhat limited and constrained. On the north side of the highway are the L-29 Canal and the L-29 levee, which extend along the entire 10.7 miles of the project segment. The view of the north side of the canal and levee is broken up by several water control structures and the Tigertail Camp. A panoramic view of the sawgrass and occasional hammocks or tree islands is largely blocked by the height of the levee. On the south side, the view is often blocked by tall vegetation along the roadside. Occasional breaks allow some distance views. The Osceola Camp and the grove of trees at the Airboat Association site provide some interest points.

2.11 NOISE ENVIRONMENT

Analyses conducted of project noise level impacts, as well as the outline of the information provided in this section and Section 5.7.11, are organized in accordance with guidance promulgated in the Florida Department of Transportation (FDOT) Environmental Management Office (EMO) Project Development and Environmental Manual (PD&E Manual), Part 2, Chapter 17, *Noise*.

The noise analysis guidance provided in the PD&E Manual is based on the regulatory material contained in 23 Code of Federal Regulations (CFR) Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise* and Florida Statute Chapter 335.17.

The facility analyzed in this noise study consists of the Tamiami Trail from a point approximately one mile west of its intersection with Krome Avenue west for approximately 10.7 miles. It is bounded on the north by the L-29 Canal and on the south by ENP.

The facility is a rural two-lane highway with a design speed of 60 miles per hour (mph) and a posted speed limit of 55 mph. The 1999 Average Daily Traffic (ADT) consisted of 5,200 vehicles per day (vpd) (Appendix C), including 11.5 percent heavy trucks, a directional distribution factor of 52.7 percent, and a peak hour to daily traffic ratio of 9.3 percent.

Section 2.0 – Existing Conditions/Affected Environment

Noise analyses performed pursuant to this study were conducted using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM), Version 1.0b. TNM computes highway traffic noise at nearby receivers and aids in the design of highway noise barriers. For this project, computer-aided design files were imported to TNM as background in order to aid in the digitizing process.

Analyses were conducted for existing conditions, future without project conditions, and the eight alternatives. Existing conditions were modeled using traffic estimates for 2000 based on the 1999 counts provided by in the Engineering Appendix. Future conditions were modeled using traffic estimates for 2020 interpolated from the 1999 data and 2022 forecasts. Traffic counts indicated a 1999 ADT of 5,200 vpd and a projected 2022 ADT of 9,200 vpd. By interpolating, ADTs of 5,375 vpd and 8,852 vpd were calculated for 2000 and 2020, respectively.

In accordance with the Transportation Research Board's *Highway Capacity Manual, Special Report 209* (HCM, Third Edition, updated 1994), and in order to analyze potential impacts in a conservative manner, projected ADTs were adjusted by a factor of 160 percent to account for heavier tourist season traffic. Using a peak hour to daily traffic ratio of 9.29 percent, design hour volumes of 800 vph and 1,316 vph were calculated for 2000 and 2020, respectively. Final adjustments to projected traffic volumes were made in accordance with HCM Chapter 8 in order to arrive at the flow rates (vph) for the peak 15 minutes, and total for both directions of flow (service flow) along the project. Previously described design hour traffic volumes were divided by proscribed peak hour factors (PHF) resulting in service flows for 2000 and 2020 of 1,030 vph and 1,400 vph, respectively.

Based on current roadway geometry and traffic as well as roadway geometry for the alternatives and projected traffic volumes, LOS-A through LOS-E per HCM (Table 6) Chapter 8 were calculated using directional distribution and lane width factors of one. Heavy vehicle factors were calculated based on data indicating 11.47 percent heavy trucks. To account for tourist season traffic, it was assumed that recreational vehicles and buses each comprised seven percent of traffic flows.

Table 6. Project Corridor Levels of Service (LOS)

LOS	Speed	Service Flow
A	= 58	= 268
B	= 55	= 512
C	= 52	= 832
D	= 50	= 1,445
E	= 45	= 2,335

LOS = Level of Service

Source: GEC, March 2001. Speed (mph) and Service Flow (total vph, both directions) based on level terrain with 20 percent no passing zone two-lane highway; directional distribution, width, and grade factors of 1; and heavy vehicle factor of 0.834.

Table 7 presents ADT, Design Hour, Flow, LOS, and Speed estimates for project area existing conditions and the alternatives.

Table 7. Project Area Traffic Data

Alternative	Year	ADT (vpd)	Design Hr.	Flow (vph)	LOS	Avg. Speed (mph)
Existing	2000	5,375	800	860	D	50
No Action	2020	8,852	1,316	1,400	D	50
1	2020	8,852	1,316	1,400	D	50
2,6,7,8	2020	8,852	1,316	1,400	D	50
3	2020	8,852	1,316	1,400	D	50
4	2020	8,852	1,316	1,400	D	50
5	2020	8,852	1,316	1,400	D	50

Source: G.E.C., Inc., 2000. ADT (vpd), Design Hr., Flow (vph), Speed (average, mph).

Unlike project air quality impacts resulting from traffic emissions, where evaluations are required for January and July, traffic noise impacts were evaluated only for the case of maximum peak-hourly traffic (January). The PD&E Manual directs evaluations of noise impacts of maximum peak-hourly traffic at LOS C; however, this analysis indicates that using the maximum peak-hourly traffic at LOS D conditions results in worst-case levels. Although traffic noise impacts are greater at higher speeds, and analysis indicates that LOS-C conditions are likely (July), resulting in average maximum peak-hourly speeds of 52 mph, the differential of two mph is outweighed by the significant increases in volume (57 percent) that are predicted for LOS D conditions (January).

Because the geometry of all current alternatives is identical with respect to HCM operational analysis, projected flow rates, LOS, and average speeds are identical for a given year and month for all alternatives.

Sensitive receivers selected and evaluated for this analysis included the Flight 592 Memorial, Osceola Camp, Safari Park, Gator Park, Tigertail Camp, Coopertown Airboats, and the Airboat Association of Florida. Three sound levels were determined for each activity; (1) noise abatement criteria (NAC), (2) existing noise levels, and (3) predicted noise levels. Table 8, from the PD&E Manual, presents NAC for the various categories of sensitive receivers.

The Flight 592 Memorial, Osceola Camp, and Tigertail Camp were analyzed with respect to Category B criteria. Safari Park, Gator Park, Airboat Association of Florida, and Coopertown Airboats were evaluated with respect to Category C criteria. As defined by FDOT, the analysis considers a noise increase of 15 dBA as substantial. Noise abatement must be considered if predicted noise levels exceed the FDOT approach criteria presented in Table 8, or if predicted noise levels increase substantially over existing noise levels.

Table 8. Noise Approach Criteria for Sensitive Receivers

Approach Criterion	Abatement Level (L _{Aeq})		Sensitive Receiver Description
	FHWA	FDOT	
A	57	56 (E)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	66 (E)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, RV parks, day care centers and hospitals.
C	72	71 (E)	Developed lands, properties, or activities not included in Categories A and B above.
D			Undeveloped lands.
E	52	51 (I)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Note: All values Hourly A-Weighted Sound Level (decibels), (E) (exterior), (I) (interior).

Source: FDOT PD&E Manual, adapted from Table 1 of 23 CFR Part 772.

Noise levels were recorded for 16.5 hours on September 29, 2000 at the Osceola Camp and for 16.5 hours on September 30, 2000 at the Tigertail Camp in order to determine background and peak hour noise levels. Measurements indicate average background A-weighted hourly equivalents (L_{Aeq}1h) of 65.8 dBA at the Osceola Camp and 58.4 dBA at the Tigertail Camp. Peak hour levels were 68.0 dBA at the Osceola Camp and 61.0 dBA at the Tigertail Camp.

Combined noise level traffic counts at the Flight 592 Memorial, Osceola Camp, and Tigertail Camp on October 10, 2000 were conducted in order to verify TNM modeling input data (roadway geometry, traffic volume and composition, receiver location, elevations, etc.) through a comparison of TNM noise level predictions with field measurements. Model predictions were within 3.0 dBA of field noise measurements.

After verifying model predictions with field measurements, peak hour existing conditions were modeled using the traffic data presented in Table 7. The existing peak hour levels are presented in Table 9. The number of receivers chosen for each site varied, depending on the likelihood that sound levels might vary across the site. Significantly, modeling indicates that the northwest portion of the Osceola Camp currently exceeds the FDOT approach criteria of 66 dBA at peak hour existing conditions.

Table 9. Existing Peak Hour Noise Levels

Site	Receiver ¹				
	1	2	3	4	5
Flight 592 Memorial	59.9				
Osceola Camp	68.3	62.0	57.5	62.2	62.6
Safari Park ²	69.6	69.9			
Gator Park	69.6	62.7			
Tigertail Camp	60.5	60.8			
Coopertown Airboats	69.6	69.9	62.7		

Note: ¹ Hypothetical points at sites for computer model analysis

² Site not actually modeled due to similarity to Coopertown Airboats site.
Values shown represent northern portion of site, in parking lot.

Source: G.E.C., Inc., 2000. All values LAeq1h.

2.12 EXISTING ROADWAY

The original Tamiami Trail was most likely constructed in the late 1920s and early 1930s primarily by digging the canal by steam shovel, dredging along the north side and throwing the spoil ahead to create the roadbed. In the mid-1940s, about 38 bridges were added at various locations within the project segment. In the early 1950s, the bridges were removed and replaced with the culverts that are currently in place. In 1968, the shoulders were widened and the pavement was overlaid. In 1970, a guardrail was added on the north side. Sometime in the 1980s or 1990s, another guardrail was added on the south side of the road. Finally, in 1993, the shoulders were widened, and the mainline pavement was resurfaced. Originally, part of the area between the edge of the shoulder and guardrail was planned to be sodded or grassed, but it was changed to asphalt sometime after final design.

FDOT requires that culverts be designed for a projected maintenance-free time or a Design Service Life (DSL) appropriate for the culvert function and highway type. Recently the FDOT Culvert Service Life Estimator Program was used with soil parameters to determine DSLs for four locations. The results indicated that the existing reinforced concrete pipe culverts under US 41 have an estimated DSL that would be in excess of 50 years, the project design life of the Tamiami Trail component of the Modified Waters Delivery program. The existing culverts have been in operation for approximately 50 years, and the Service Life Program estimates indicate that they should continue to provide the required service to US 41. After the pavement was resurfaced in 1993, the first pavement condition rating was conducted in 1994. The results yielded an excellent rating in rutting, ride, and pavement conditions; however, the pavement cracking condition was rated as 6.0 on a 10-point scale.

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An annual maintenance cost expended by FDOT over the past three years has averaged \$39,537. FDOT District 6, which is responsible for this portion of the Tamiami Trail, expects maintenance costs to increase for the shoulder pavement repairs because of the age of the shoulder and its rate of deterioration. The costs can be expected to increase annually as the shoulders continue to deteriorate and the guardrails continue

to degrade. Due to deterioration of the pavement in terms of cracking, rutting, and ride, FDOT determined that the portion of the Tamiami Trail within the project area is in need of rehabilitation. The highway is scheduled for improvement in the year 2002 at an estimated cost of approximately three million dollars, excluding maintenance of traffic costs.

2.13 TRANSPORTATION

In 1999 the Governor's Hurricane Evacuation Task Force identified seven limited access routes with a potential "need to reverse" to enhance regional evacuations (FDOT web site). US 41 (Tamiami Trail) is not one of the "officially designated" routes. However, due to its location as the southern-most east-west artery in the state, Tamiami Trail provides critical eastbound and westbound coast-to-coast access between Miami and Naples and would be utilized for evacuation, if necessary. Traffic would be maintained in both directions. The closest "officially designated" eastbound and westbound coast-to-coast hurricane evacuation route (with a need to reverse lane) is Interstate Highway 75 (Alligator Alley), which is located approximately 20 miles north of Tamiami Trail.

The use of Tamiami Trail as an "implied" evacuation route would require that the highway's capability to be utilized for evacuation be maintained during hurricane season. This may influence construction phasing and maintenance of traffic flows during construction (Appendix C).

Access to the Tigertail Camp, which is located on the northern side of the L-29 Canal across from the highway, is via motor vehicle and boat. Vehicle access is by means of unimproved roads adjacent to and on top of the L-29 Levee. The levee roads connect with the Tamiami Trail by canal crossings at each end of the project area. There is a small parking area along the northern side of the highway across the canal from the Tigertail Camp, with boat docks located adjacent to the parking area and also across the canal at the residential area. Boat access to the Tigertail Camp appears to be quite efficient, offering an alternative to driving several miles along the unimproved levee roads.

2.14 TRIBAL LANDS

The Miccosukee Indian Tribe has lived in what is now ENP for generations and has traditional, aboriginal, and statutory rights to live in the Everglades.

There are two Miccosukee Tribe family group settlements within the project area: the Tigertail Camp and the Osceola Camp. The Tigertail Camp is located north of Highway 41 between the L-29 Canal and L-29 Levee. This camp is home to approximately 15-20 persons. Access to the Tigertail Camp is by road on the north bank of L-29 Canal or by the road on L-29. A parking area with boat access is along the Tamiami Trail opposite the camp. Some of the persons living at the camp park vehicles alongside the highway and ferry across the L-29 Canal by boat. The living facilities of the Tigertail Camp were recently elevated above the flow levels anticipated for MWD.

The Osceola Camp is home to 10-15 people. It is located on the south side of the Tamiami Trail approximately one-half mile east of the western end of the project area. Access is by vehicle directly from the highway. Structures in the Osceola Camp have not yet been raised above the MWD Project higher water elevations; but plans to raise this camp are now in preparation.

This report does not present information on private areas, and it identifies only those areas affected by the project.

2.15 ECONOMICS/SOCIOECONOMICS

The project study area is west of the "limits to urbanization" boundary established by the Miami-Dade Planning Department. Coupled with the protected natural areas north and south of the corridor, this effectively means that no additional development will be allowed along the corridor within the project limits.

The Miami-Dade County region is a major metropolitan area with a population in excess of two million people. There is a diverse economy with an emphasis on tourism, wholesale and retail trade, manufacturing, and shipping/transport. Miami-Dade County, which encompasses more than 2,000 square miles, is located along the southeastern portion of the Florida peninsula. It is bounded by Biscayne Bay and the Atlantic Ocean to the east, ENP to the west, the Florida Keys to the south, and Broward County to the north. One-third of the Miami-Dade County area is within the boundary of ENP.

The population of the county is approximately three-quarters white and slightly less than one-quarter black. Approximately 55 percent of Miami-Dade residents identify themselves as Hispanic. In 1996 it was estimated that almost one-quarter of the county's residents were in poverty, with almost 40 percent of that number being children under the age of 18. Almost 1.2 million people had full or part-time jobs. Over 1.0 million were in private employment. Local, state, and federal government employment accounted for approximately 150,000 jobholders.

Three tourist-oriented businesses located on the south side of Tamiami trail in the study area offer airboat trips, souvenirs, and restaurant facilities. The particular attraction of the businesses is ecotourism, i.e., guided airboat tours into ENP with explanations about the nature of the everglades as an ecological area, and information on some of the flora and fauna. According to the owners/managers of the businesses, approximately 90 percent of all the visitors who stop do so in order to inquire about or take the airboat tours. (Personal communication-business owners/managers, multiple dates, 2000)

The three businesses have approximately 15 permanent residents among them. One also has recreational vehicle sites, many of which are occupied for extended periods by "semi-permanent" residents. The businesses also employ approximately 30 full time and 20 part time people.

2.16 FLIGHT 592 MEMORIAL

The Valu Jet Flight 592 Memorial is located at the western end of the project area on the northern side of the L-29 Levee. The site consists of a parking area and a sculpture/memorial consisting of 110 concrete pillars that symbolize each of the lives lost in the DC-9 crash on May 11, 1996. The pillars are arranged in a triangular pattern that points to the actual crash site eight miles away in the Everglades.

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